

# Air Sensor

## FCS Ex

### Manual



AQ Elteknik AB

# **Air Sensor**

**Model FCS Ex**

**Manual version 2.0**

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**AQ Elteknik AB**



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# 1. Manufacturer information

**AQ Elteknik AB** operates a policy of on-going development and reserves the right to make changes and improvements to any of the products described in this users guide without prior notice.


Under no circumstances shall AQ Elteknik be held responsible for any loss or indirect damage howsoever caused. The contents of this document are provided as it is. AQ Elteknik AB reserves the right to revise this document or withdraw it at any time without prior notice.

## Manufacture Declaration of Conformity

Manufacturer: AQ Elteknik AB Sweden declares, that the product:

Air Sensor marked with CE-label conforms with the following standards: EN 61000-6-2:2001, EN 61000-6-4:2001, EN55011 (Group 1, Class B).

The Air Sensor is RoHS Compliant, directive 2002/95/EC.

Air Sensor marked with  conforms to WEEE. When the Air Sensor is to be discarded it shall be sent back to AQ Elteknik AB for safe disposal. See "Manufacturer Information" for return address.

Before sending the Air Sensor to AQ Elteknik AB it must be clean and without any harmful contaminations.

A certificate shall be attached with the Air Sensor that confirms the cleaning and shows information:

- Who has cleaned the Air Sensor (company if other than sender)
- Who has checked and confirmed that the Air Sensor is clean (company and person)
- Who is sending back the Air Sensor (company)

## Limited Warranty

AQ Elteknik AB warrants to the original end user that the Air Sensor is free from any defects in materials or workmanship for a period of one year from the date of purchase. During the warranty period, should the Air Sensor have indications of failure due to faulty workmanship or materials, AQ Elteknik AB will replace it with no charge. This warranty shall not apply if the Air Sensor is modified, misused or subjected to abnormal working conditions.

Replacement as provided under this warranty is the only remedy of the purchaser. The purchaser pays freight to AQ Elteknik AB. AQ Elteknik AB shall in no event be held liable for indirect or consequential damages of any kind or character to the purchaser.

## Warning

The Air Sensor is intended to be used with the Ultrasound Controller manufactured by AQ Elteknik AB. AQ Elteknik AB takes no responsibility for any possible damage that could happen if the Air Sensor is connected to any equipment not manufactured by AQ Elteknik AB.

## Manufacturer information

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## 2. Introduction

### Air Sensor

Liquid flowing through the Air Sensor is monitored with ultrasound and the presence of gas or particles is detected by the connected Ultrasound Controller. The Air Sensor is reliable and easy to use. It is turned from one piece and the inside is completely smooth with low Ra-value

### Ultrasound Controller D72 / DP72

Ultrasound Controller D72 / DP72 are recommended for use with the Air Sensors. It mounts on a DIN-rail and can be connected to two Air Sensors.

## 3. Functional Description

### Principle of Bubble Detection

Bubbles in the liquid flowing through the Air Sensor are monitored by the use of ultrasound.

Inside the Air Sensor two low intensity beams of ultrasound are transmitted across the liquid-path in directions perpendicular to the liquid flow.

If a bubble moves into one of the ultrasound-beams the ultrasound will be partially reflected and the intensity of the ultrasound will decrease. The controller constantly measures the intensity of the ultrasound and if the intensity becomes lower than the threshold it detects a bubble. Also dense material can reflect the ultrasound in a similar way as bubbles and will be detected.

### Sensitivity

The sensitivity for bubbles can be set to high, medium, low, very low and very very low. (How to set it, see the users guide for the D72 / DP72 ultrasound controller.)

With sensitivity set to high (threshold 40%) a single bubble of approximately 2mm diameter or larger can be detected passing through the Air Sensor.

With sensitivity set to medium (threshold 25%) a single bubble of approximately 3mm diameter or larger can be detected.

With sensitivity set to low (threshold 25%) a single bubble of approximately 10mm diameter or two smaller bubbles (3mm) can be detected. Low sensitivity is achieved in the Air Sensor by requiring both ultrasound-beams to detect bubbles at the same time. Since the two ultrasound-beams are separated by a short distance in the direction of the liquid-flow, there must either come a very big bubble or two smaller bubbles in order to achieve a bubble-detection.

Tiny (microscopic) bubbles are usually evenly distributed in the flowing liquid and will be detected with sensitivity set to high, medium or low if the amount of bubbles are high enough.

With sensitivity set to very low or very very low sensitivity a different measuring technique is used making the Air Sensor very insensitive for bubbles of any size, even tiny (microscopic) bubbles. However the Air Sensor detects when it is empty. When using very low sensitivity the Air Sensor should preferably be installed with vertical liquid flow since otherwise lingering liquid lying inside the horizontal Air Sensor could be detected as liquid.

## 4. Installing the Air Sensor

One or two Air Sensors can be connected to one Ultrasound Controller D72 or DP72. The Air Sensor should be installed in accordance with national regulations. A person with the required knowledge should perform installation.

### Cable

The cable from the Air Sensor connects to the barriers (hazardous side). The maximum cable length is 10m. A similar cable connects the barrier (safe side) to the Ultrasound Controller D72 / DP72. The cable-screen is important because it prevents external noise from entering. Therefore all cables must be screened and the screen connected to ground. The inner screen of the cable is connected to ground at the barrier. In addition to that the outer screen may be connected to ground via a screened cable gland.

**NOTE!** The unscreened part of the cable should be kept very short.

### Vertical or Horizontal Installation

Although the Air Sensor can be installed horizontally it is better to install it vertically because then bubbles will be drawn to the center where sensitivity is highest and when the flow stops bubbles will not linger inside the Air Sensor.

## 5. Connecting the Air Sensor

### Connecting the Air Sensor Ex using barriers

The Ultrasound Controller D72 or DP72 is not ex-certified and intrinsically safe barriers must be used to connect the Air Sensor Ex. The diagram below shows how to connect two Air Sensors FCS Ex via four barriers. It is important to install the barriers and the sensors according to EN 60079-14 and to summarize the voltage and current according to appendix B.

Two zener barriers are needed for each Air Sensor.

In the diagrams, the cable type between D72 / DP72 and the barriers is the same type as between the barriers and the Air Sensors.

### Choosing a barrier

The barrier must be chosen according to EN 60079-14, but there are also measurement considerations for choosing the barrier:

1. The barrier must use resistive current limitation.
2. The barrier must be made for AC current.
3. The barrier voltage should be as high as can be allowed. (minimum  $\pm 8V$  AC)
4. The barrier resistance should be as low as can be allowed. (maximum  $110\Omega$ )
5. The barrier must attenuate 2MHz as little as possible. The barrier capacitance to ground should be as low as possible.

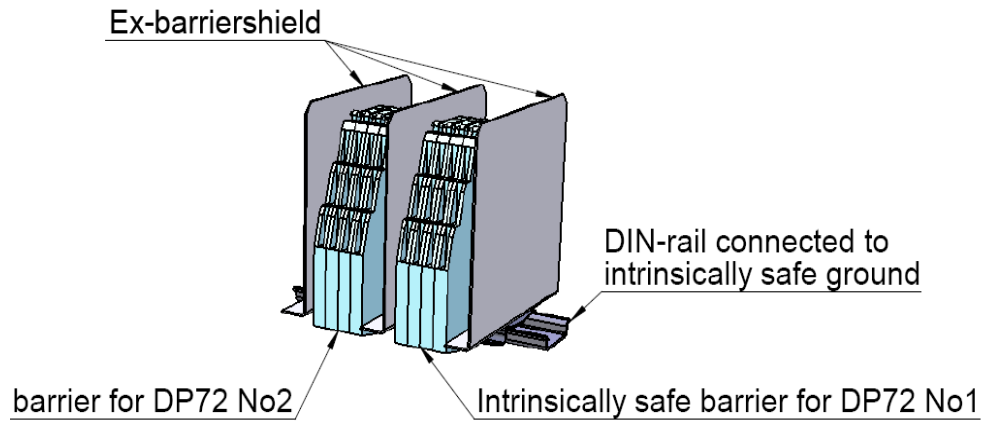
**Recommended barrier:** Pepperl+Fuchs Z960.

## Ex-barriershields

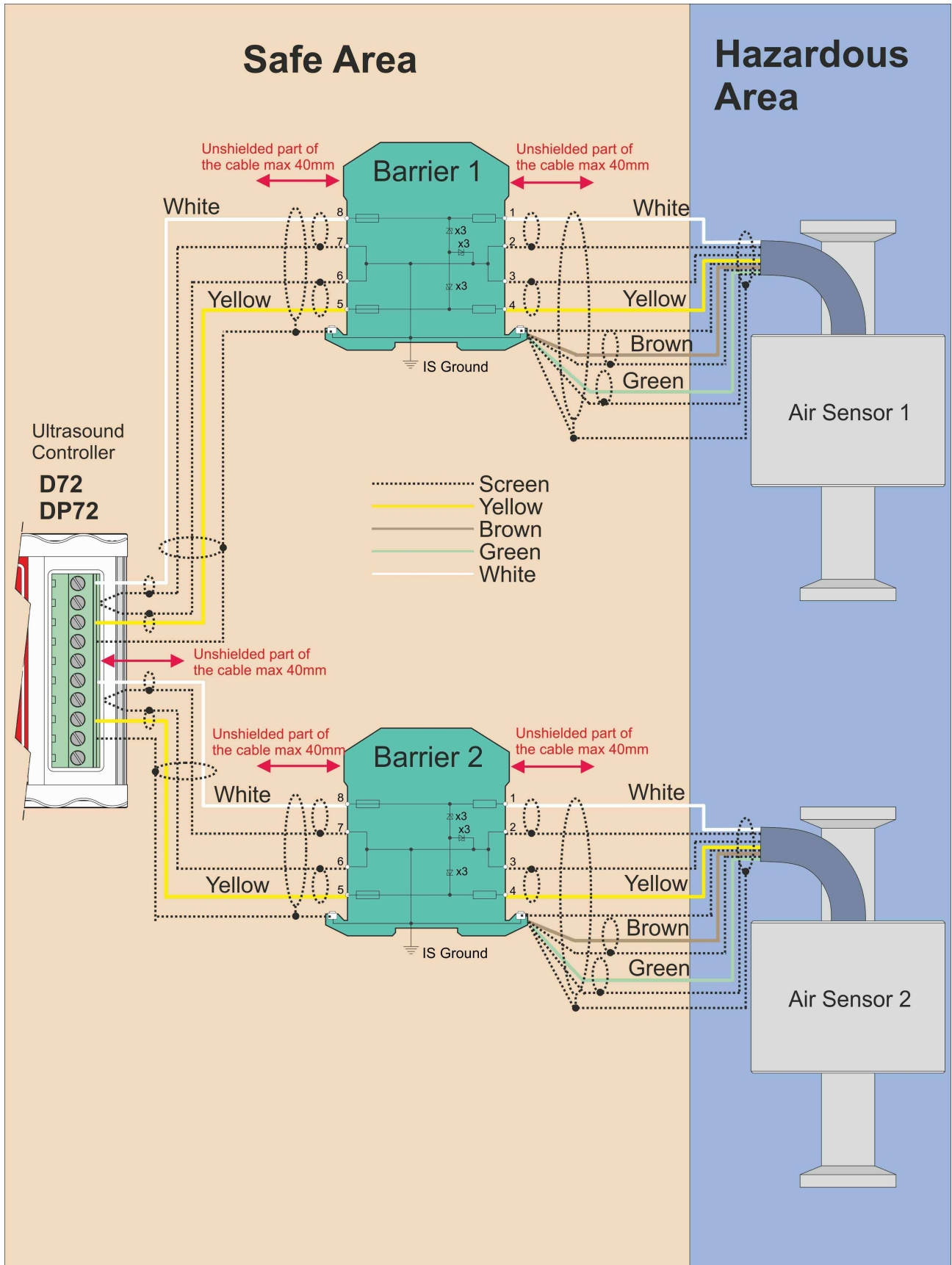
The zener barriers are not shielded so noise can interfere when weak signals are being measured. To reduce noise interference, **shielding aluminum plates must be placed** outside each group of barriers belonging to each Ultrasound Controller D72 / DP72, see picture.

Shielding aluminum plate must be ordered separately, item no: Ex-barriershield.

The Ex-barriershield snaps on to the DIN-rail next to the intrinsically safe zener barriers.



# Connecting Air Sensor FCS via barriers to Ultrasound Controller D72 or DP72





## 6. Ex description

The Air Sensor - Ex is made to be used in Apparatus-group IIB and Equipment-group 1/2G. The inside of the conduit of the sensor is designed to be exposed to zone 0 and the remaining parts to zone 1. The sensor is transmitting ultrasound into zone 0. Notice that Ultrasound Controller D72 is not Ex certified and barriers must be used to connect the Air Sensors. Common regulations for installation and maintenance of explosive protected electrical equipment shall be observed. (EN 60079-14 and EN 60079-17 in European countries connected to CENELEC). Special conditions for use according to certificate SP 04ATEX3622X concerning the Air Sensor:

1. The cable from the barrier to the Air Sensor shall be permanently installed, mechanically protected and protected from other environmental stress in order to ensure explosion protection. A person with the required knowledge should perform installation.

2. The current limitation of the intrinsically safe barriers connected to the Air Sensor must be resistive with linear characteristic

3. The enclosure of the Air Sensor must be connected to earth via the mounting in the conduit system.

### Label information written on Air Sensor Ex

Air Sensor Made in Sweden

Type	see Technical specifications
Inner diameter	see Technical Specifications
Ex Class	CE Ⓜ II 1/2 G EEx ia IIB T4
SP No.	SP 04ATEX3622X
Transport temp.	Tamb: -20 to +60 °C
Max input voltage	Ui: 9,0V
Max current input	Ii: 480mA
Max power input	Pi: 1,1W
Inner capacitance	Ci: 200nF
Inner inductance	Li: 0,05mH

## 7. Air Sensor settings

### Setting the Filter (Integration and delay time)

In order to avoid detection of single small bubbles or to avoid unnecessary bubble detections when some amount of bubbles can be accepted there is a filter. The filter can be set to different integration times and also different delay times.

Setting the filter to integration means the duration of each bubble detected is added to the integration-sum and when the sum becomes higher than the set value the controller indicates air (for a minimum of 1s). The integration-sum is then reset to zero as soon as liquid is again detected. The speed by which the integration-sum increases depends both on the amount of bubbles and on the flow-rate.

Setting the filter to delay means the controller indicates air only after bubbles has been detected continuously for duration of the set time.

### Sensitivity and Measurement Accuracy

The measurement accuracy depend on how well the Air Sensor is calibrated, the flow-rate, the type of liquid, how the Air Sensor is mounted and weather there is a single bubble or many bubbles.

Set higher SENSITIVITY and set shorter FILTER-integrate-time if too many bubbles pass the Air Sensor without being detected.

Set lower SENSITIVITY, set longer FILTER-time and change from FILTER-integrate-time to FILTER-delay-time if too few bubbles pass the Air Sensor before being detected.

## 8. Calibration

### Calibration

Make sure there is liquid inside the Air Sensor and calibrate it according to the manual for the controller used. The calibration adjusts the intensity of the ultrasound-beams to 100%. Each Air Sensor should be calibrated after installation. After the first calibration it is advisable also to check the detection of air.

A new calibration may be required if the liquid properties has changed significantly since the last calibration

With air in the Air Sensor some sound also travels along the walls producing an error signal. This error signal should be less than 15%.

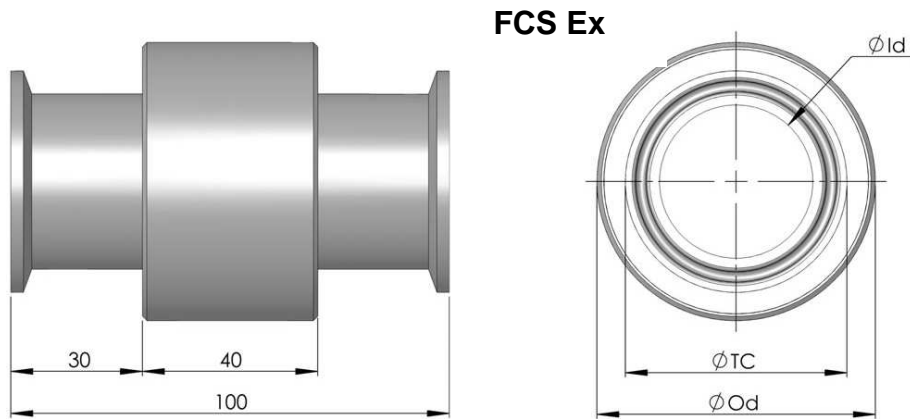
## 9. Troubleshooting

Problem	Possible cause	Corrective action
Air Sensor does not indicate liquid or air when it should “DATA dB” with liquid shows too high value “relative DATA” shows too high value with air	Air Sensor type setting is wrong	Change Air Sensor type setting
	Air Sensor is connected wrong	Make correct connection
	Air Sensor is not calibrated	Calibrate Air Sensor
	Bubble is lingering inside Air Sensor	Remove bubble
	Air Sensor is faulty	Replace Air Sensor
Air or Liquid is indicated on the display but the relay does not move	Relay setting is wrong	Change relay setting

# 10. Technical specifications

Operating temperature range	0°C to 60°C
Maximum temperature range*	-20°C to 60°C
Maximum pressure	FCS: 1Mpa / 10 bar g at operating temperature range
Protection class	IP67
Finish in pipe (Ra-value)	<0,375 µm / <15 micro inch

\*Proper indication of bubbles is not guaranteed at temperatures outside operating temperature range



## Air Sensor FCS Ex dimensions

Model number	Inner diameter (mm)	Outer diameter (mm)	Tri Clamp diameter (mm)	Material
FCS10-25 Ex	10	51	25	Stainless steel 316L
FCS16-25 Ex	16	51	25	Stainless steel 316L
FCS16-50 Ex	16	64	50	Stainless steel 316L
FCS22-50 Ex	22	64	50	Stainless steel 316L
FCS35-50 Ex	35	64	50	Stainless steel 316L
FCS46-64 Ex	46	76	64	Stainless steel 316L